INFLUENCE OF AGE AND WEIGHT OF GILT ON BREEDING PERFORMANCE AND FEED INTAKE DURING GESTATION AND SUCKLING PERIOD

By

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THESIS

Submitted in partial fulfilment of the
requirement for the degree

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DECLARATION

I hereby declare that the thesis entitled **"INFLUENCE OF AGE AND WEIGHT ON BREEDING PERFORMANCE OF GILT AND FEED INTAKE DURING GESTATION AND SUCKLING PERIOD"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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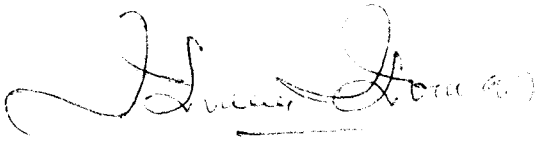
CERTIFICATE

Certified that this thesis, entitled **"INFLUENCE OF AGE AND WEIGHT ON BREEDING PERFORMANCE OF GILT AND FEED INTAKE DURING GESTATION AND SUCKLING PERIOD"** is a record of research work done independently by **Sri. A. Kannan,** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.



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Introduction

INTRODUCTION

Livestock production has long been a man's primary occupation in most of the countries in the world. With todays increasing population and its ever increasing consumption of meat, swine production is assuming a leading role in agricultural income.

With increasing human population, India is facing shortage of meat and meat products. To overcome the low availability and high requirement, it is essential to make all efforts to improve and enhance the availability of meat producing animal.

From the point of efficient production of meat, pigs excel other livestock and play a vital role in the economy of the country as they are good converters of feed into meat for human consumption. They are tolerant to wide variety of feed and can make full and efficient use of the farm and other products which would otherwise be wasted. They are prolific and can be raised in small areas either in a close confinement or a pasture.

In tropical countries, pig production has a great potential, as it can successfully and economically be raised. It requires only low cost building and other inputs are

comparatively low and brooding facilities required for young pigs are minimal.

In India pig farming has a special significance as it can play an important role in improving the socio-economic status of a sizeable section of rural community.

The success and efficiency of pig farming depends upon the reproductive performance of the pigs. Swine producers must exercise a continuous effort to regulate the swine breeding unit if financial profit is to be a reality. Maintaining optimum litter size at birth and increasing the overall efficiency of the breeding herd offer opportunities for assuring a productive swine unit. About 30-40 per cent of sow herd is replaced by gilts each year and the stage at which gilt is bred for the first time has been an important implication on efficiency of its life time production.

In our country, for a long period of time pig rearing was carried by rural people, who traditionally practised it. They do not have the knowhow and technique of pig production in modern line, although pig production itself is a relatively new venture. There is a lot of scope for improvement and many farmers are not efficiently utilizing the resources at their disposal. Much wastage of this resource may be the result of a lack of understanding of the reproductive ability of the

pig. The Farmers believed in mating females at younger age or lighter weights in order to improve the total efficiency of breeding herd (Brooks and Cole, 1973). It is costly to keep a non-productive animal. Financial success therefore largely depends on the optimum mating age, weight at satisfactory ovulation, conception and litter performance.

In swine production cost of the feed normally represents 70 to 80 per cent of its total cost of production. Consequently, profit from the swine enterprise is directly affected by the extent to which efficient and economical use of feeds have been made.

The maximum exploitation of the production potentiality of breeding gilt demands a superior post weaning performance. The lactation stress on the animal is the real obstacle in the achievement of this aim.

Hence it has become necessary to have a better understanding of age and body weight at first mating and the litter performance. It would be an advantage and beneficial to the farmer, if the optimum age and body weight of gilt at first mating to give maximum litter output are known. This would minimise the cost of production and maximise the net return from the gilt.

In the light of the foregoing resume the present study was undertaken with following set objectives.

1. To find the influence of age and body weight of gilt on breeding performance;

2. To determine the optimum age and weight for breeding of gilts; and

3. To find the influence of age and weight at breeding of gilts on feed intake during gestation and suckling period.

Review of Literature

REVIEW OF LITERATURE

2.1 Patterns of growth in pigs

Growth of meat animals represented by increase in size and weight with age, and development which consists of the changes in body proportion and composition as the animal grows from conception to maturity, are of great economic significance (Poemeroy, 1978). Each animal has an inherent mature body size towards which it grows at a genetically controlled rate (Brody, 1945). Brody (1945) considered growth in terms of size as well as weight and defined growth as a relative irreversible time change in the measured dimension or function. Growth, form and function of an animal are closely interrelated.

Growth may considered to be a combination of physical processes such as hyperplasia and hypertrophy which induce volumetric development and chemical changes, which are responsible for physiological maturation. This growth may be considered from at least two aspects.

a. an increase in body mass with time and

b. changes in form or composition resulting from different growth rates of component parts.

2.1.1 Body weight

Brody (1945) recorded the body weight (kg) of female pigs at different ages as follows.

Age in months	2	4	6	8	10	12
Body weight in kg	8.0	23.0	55.0	94.0	126.0	152.0

Agorwala (1961) reported pigs attaining 90 kg (197 lbs) in 6 month of post weaning period.

Mahadevan (1962) recorded a growth level of 68 kg body weight during 33 weeks (8 months) period. Saxena (1968) reported 62-82 Kg weight level could be reached in 48 weeks (11 months). Bhagwat and Sahastrabuddhe (1971) recorded the body weight (kg) of Yorkshire pigs at different ages as follows:

Age in months	2	3	4	5	6
Male	11.46	15.75	27.50	42.19	62.96
Female	10.75	13.57	23.85	35.64	54.64

Sassendran (1979) recorded body weight (kg) of large white Yorkshire pigs at different ages as given below:

Age in weeks	8	12	16	20	24	28	30
Male	15.08	19.42	33.08	47.33	57.25	72.66	83.66
Female	13.58	18.50	32.58	46.74	57.00	70.83	79.66

Gupta (1983) reported that for Large White pigs weaning weight at 8 weeks averaged 9.4 kg (range 8.4 to 11.1 kg). At 16 weeks body weight averaged 19.1 kg (range 15.9 to 22.2 kg). At 18 weeks, the body weight averaged 26.0 and 26.5 kg for males and females, respectively. the ranking of pigs on body weight at 8 and 18 weeks was not the same.

Sharma et al. (1990) reported that for Landrace, Large White, desi, Landrace x desi and Large White x desi respectively, weight at 8 weeks of age averaged 9.63, 9.79, 5.30, 6.68 and 7.62 kg and at 30 weeks 41.8, 33.7, 19.9, 25.9 and 30.3 kg.

For Large White pigs weight at birth, 8 weeks and 16 weeks of age averaged 1.30, 7.77 and 12.07 kg respectively while 0.52, 3.50 and 5.22 kg for desi pigs and 0.91, 7.23 and 11.52 kg for Large White x desi cross breds. Post weaning daily gain for the three groups averaged 65.6, 28.8 and 69.1 g and food conversion ratio 4.45, 4.95 and 4.62 (Singh et al., 1990).

Pradhan (1993) found the average body weights for the Large White pigs fed with standard rations from weaning to 40 weeks of age were increased from 9.00 $\pm$ 0.34 kg and 85.36 $\pm$ 1.37 kg respectively.

2.1.2 Growth curve

Growth curve of swine have been described by several authors. The data of Bywaters and Willham (1935) and Ittner and Hughes (1938) suggested a smooth curve with a linear growth between about 70 and 168 days with a diminishing increment after 168 days. Post weaning body weight curve between 134 and 174 days of age (Taylor and Hazel, 1955) and between 53 and 346 days (Abarca and Tapia, 1963) were found to be linear. On the other hand, the data of Donald (1940), Lush and Kincaid (1943) showed that a quadratic equation best fit the data. Similarly, the data of Quijandria and Robison (1971) covering the ages 119 to 154 days with a final weight of approximately 82 kg and the data of Standal (1973) covering an age range of 135 to 225 days with a final weight upto 130 kg suggested a quadratic growth model. However, the percentage of the variation accounted for was only slightly larger than for the linear model (less than 1 per cent). Also, the data of Doornenbal (1971) with an age range of 78 to 210 days and a final weight of 130 kg though suggested a significant quadratic regression the quadratic term accounted for only one per cent of the variance. It appeared that in swine the quadratic function was significant statistically but of little biological (practical) importance for post weaning gains to about 130 kg (Robison, 1976).

While Joubert (1963) linked the point of inflection which separates the rising and declining segments of growth curves with the concept of puberty, Robinson (1976) observed that such a concept could not be clearly established. However, Matousek et al. (1989) observed that point of inflection of the growth curve occurred at 169.5 days of age and 90.7 kg body weight with the decrease in growth rate being highest at 215.9 days in commercial hybrid pigs born to Landrace x Czech Improved White and Sired by Duroc x Belgian Landrace boars.

According to Jung et al. (1989) growth curves indicated that daily gain in Large Whites was the highest at 130 and 123.9 days of age for male and females respectively (1.029 and 0.824 kg), and the corresponding figures for Landrace were 132.7 and 112.9 days (1.013 and 0.780 kg). Pavilk and Pulkrabek (1989) on analysis of growth curve traits, observed that the age at highest average daily gain averaged 122.5 to 169.6 days for prestic and 116.7 to 167.1 days for Large White pigs.

Kanis and Koops (1990) reported that the maximum daily gain was, on an average at live weight of 64 kg for barrows and 77 kg for gilts.

2.1.3 Rate of growth

According to Pomeroy (1955) the rate at which an animal grows is of greater importance for the livestock owner than its mature weight as only a few animal live long enough to reach the mature weight. There is close correlation between rapid growth and good life-time performance.

Mugge (1961) from his experiment on German Landrace pigs observed that from 50 kg each gain of 10 kg took about 14 days. Daily gain from 40 to 110 kg was 704 to 723 g. While from 30 to 100 kg daily gain was 639 to 701 g. Brooks et al. (1964) observed that in the successive periods from birth to 50, 50 to 100, 100 to 150 and 150 to 200 lb average daily live weight gains were 0.70, 1.52, 1.76 and 1.96 lb, respectively.

Daily weighing of spotted Belorussian pigs from birth to 10 months of age revealed that there was a rhythm of growth rate with peaks at intervals of 12 days not being significantly affected by sex or season of birth (Thompson, 1965).

Walstra (1980) observed that animals grew well upto 36 weeks of age (125-165 kg live weight) with maximum growth between 13 to 24 weeks of age for boars and gilts and between birth to 18 weeks for barrows.

Morrison (1984) reported that growth rate in pigs increased gradually until the pig reached a weight of about 102 kg and then decreased slightly. When carried to higher weight than 136 kg the rate of gain was considerably less.

Schmitten et al. (1986) reported average daily gains of 753, 758 and 712 g for Pietrain x German Landrace pigs finished to 80, 100 and 120 kg respectively.

Pavlik et al. (1988) observed in Czechoslavakian Large White pigs that body weight ranged from 23.4 kg at 80 days to 101.1 kg at 180 days. Daily gain averaged from 667 g at 81 to 90 days to 817 g at 121 to 130 days. From 30 to 100 kg daily gain averaged 773 g, and feed efficiency 2.06 kg.

Gu et al. (1991) working on barrows of various crosses involving Hampshire, Yorkshire, Landrace and Duroc breeds, observed that among the three growth periods (50 to 100 kg, 73 to 114 kg, 86 to 127 kg body weight) daily gain was the highest in the second period (73 to 114 kg).

2.1.4 Feed consumption, feed efficiency and weight gain

Magee (1962) reported a linear relation between daily gain and daily feed consumption, however, there was a negative correlation between daily feed consumption and feed efficiency. Biswas et al. (1966) also reported that daily

gain was positively correlated with daily intake of feed and efficiency of feed conversion, and intake was negatively correlated with efficiency. Various workers have reported that feed efficiency decreased with increasing weight (Wallace et al., 1959; Mugge, 1961; Buck, 1963; Gu et al., 1991). It was pointed out that decrease in feed efficiency with increasing weight was primarily due to increased maintenance costs and not to increased fat deposition (Robison, 1976). Robison (1976) reported that rate of growth was highly correlated with feed efficiency.

Holme (1963) reported a decrease in rate of gain and feed efficiency with increasing slaughter weight from 170 to 290 lbs. Mugge (1963) by comparing the growth performance over period from 20 to 90, 30 to 100 and 40 to 110 kg live weight, found that the period 30 to 100 kg had several advantage including lower feed consumption for the same gain.

Nowicki et al. (1963) reported that the daily gain to respective live weights of 100, 115, 130 kg were for large whites 650, 678 and 641 g and for Swedish Landrace 628, 625 and 690 g. Intakes per kilogram gain, in that order, were 4.35, 4.52, 4.86, 4.50, 4.76 and 5.14 feed units.

For male and female Duroc pigs, daily gain averaged 246 and 246 g respectively, from birth to 20 kg body weight,

294 and 306 g from 60 to 80 kg, 420 and 406 g from 80 to 90 kg, 469 and 446 g from 110 to 120 kg and 484 and 485 g from 120 to 130 kg. The consumption of feed units per kilogram gain to 40, 60, 80, 90, 100, 110, 120 and 130 kg averaged 3.5, 3.4, 3.7, 3.8, 3.8, 3.9 and 4.0 respectively. The correlation of daily gain with body weight and age were highly significant (Koinarski, 1983).

For barrows and gilts kept to 220 days daily gain averaged 626 and 549 g and feed efficiency 2.30 and 2.02 kg respectively. At 240 days, daily gain averaged 624 and 536 g, and feed efficiency 2.38 and 2.08 kg, while at 260 days, daily gain averaged 573 and 552 g and feed efficiency 2.29 and 2.09 kg respectively (Otto et al., 1983).

For Yorkshire boars, barrows and gilts respectively, weight gain averaged 46, 45.5 and 49.0 kg, daily gain 365, 361 and 388 g; feed consumption per day 1.76, 1.78 and 1.86 kg and feed conversion ratio 4.83, 4.95 and 4.81, between day one (15 kg body weight) and 126 between days 126 and 159, weight gain averaged 11.5, 11.0 and 8.3 kg, daily gain 360, 360 and 280 g. Feed consumption per day 1.80, 2.66 and 2.07 kg and feed conversion ratio 5.0, 7.4 and 7.4 (Kumar and Barsaul, 1987).

Albar et al. (1990) reported that increase of slaughter weight by 10 kg from 105 to 125 kg resulted in

increased food consumption by 0.10 to 0.15 kg feed per kilogram of gain

Pradhan (1993) found tht pigs total feed consumption increased from 11.30 ± 0.23 to 444.68 ± 12.58 kg with daily feed intake increased from 0.807 ± 0.016 to 1.985 ± 0.056 kg from 10th week to 40th week of age respectively and showed the daily gain in weight increased from 131.62 ± 17.38 g at 10th week to a peak of 392.28 ± 9.34 g at 32nd week, thereafter declining to 384.60 ± 6.98 g at 40th week of age. Feed conversion efficiency of 6.92 ± 0.97 was noticed at 10th week, gradually improving to 4.88 ± 0.39 at 14th week and thereafter kept steady at 3.62 ± 0.10 to 4.43 ± 0.32 from 16th to 30th week, followed by a gradual decline to 5.19 ± 0.09 to 40th week of age. The maximum feed conversion efficiency of 3.62 ± 0.10 was recorded at 24th week of age.

2.2 Genitalia development

Establishment of biometrical norms of the organ of genitalia has been done by various workers in different domestic animals. Sission (1910) the Veteran anatomist has published in detail the measurements of the normal genital organs of all domestic animals. Subsequently many more reports have found place in literature.

Brody (1945) reported that the visceral organ weights in mature animals of different species increased with a fractional power of body weight, that is, the weights of visceral organs did not increases as rapidly as the body weight as a whole. The ratio of visceral organ weight to body weight declined with increasing body weight.

Tutarov (1961) reported total weight of genitalia was four times greater in nine months old than in six months old. The weight of ovaries was not appreciably different at various ages, but uterus was better developed in nine months old. Its concluded that genitalia are not fully developed until body weight in at least about 80-90 kg. Consequently poorer litter performance when gills mated earlier.

Hafez (1987) recorded the measurements of various components of porcine genitalia as the length of vagina, cervix, body of uterus, uterine horn and fallopian tube are 10-15 cm, 10 cm, 5 cm, 40-65 and 15-30 an respectively.

Nair (1970) conducted the biometrical study on genitalia of 241 Yorkshire female pigs between four and 53 months of age and concluded that development of vagina, cervix, body and horns of uterus, Fallopian tubes, ovaries and gross weight of organ had a mutual and direct relationship with age.

Chertkov (1976) investigated length of oviduct and uterine horn, weight of ovaries, and number of corpusluteum were correlated with age.

Konyukhova (1983) reported gilts were slaughtered at various ages from 180-241 days or older and measurements of genitalia were made during sexual maturation, the length of uterine horn and weight of uterus increased by factors of 1.7 and 3.0 respectively.

Prunier and Bonneau (1987) found ovarian weight was mainly depend on live weight in cyclical as well as prepubertal gilts. In the latter weight and length of uterine horns, cervix were influenced by both age and live weight whereas in cyclical gilts, only obvious effect was that age on uterine horn weight.

Wu et al. (1987, 1988) and Christenson et al. (1987) indicated that age and body weight at mating of gilts significantly correlated with length of uterine horn and number of corpusluteum. Number of foetuses (-0.39) and prenatal mortality (-0.49) were closely related with length of uterus and it was appeared to be an important limiting factor to litter size as number of corpusluteum increased.

Cambo et al. (1987) found there were no significant difference between the right and left ovaries or weight of horns in the number of corpusluteum or embryos.

Das et al. (1988) studied on 118 non gravid genitalia of Landrace gilts with four different age groups as found that age had significant influence on biometrical measurements of different organs.

2.3 Ovulation rate

The term ovulation rate is used to describe the number of ova shed at any particular oestrous period. It thus represents the potential litter size of pig from that particular oestrous, although, losses may subsequently occur due to failure of fertilization and mortality during pregnancy.

Ovulation rate is influenced by factors which are, Intrinsic to individual animal such as age and genotype, and those which may be modified by nutrition, environment and the use of exogenous hormones.

Since increase in age and parity are usually associated with increase in body weight, it might be expected that ovulation rate would also be correlated with the weight of the animal. However, body weight is a manifestation of

many interacting factors such as age, breed, nutrition and disease.

There is much conflicting evidence concerning the influence of absolute weight on ovulation rate. In many experiments, no relationship has been found between the two, in either the gilt (Zimmerman et al., 1960; Kirkpatrick et al., 1967) or the sow (King and YOung, 1957; Hardy and Lodge, 1969). However, Heap et al., 1967) have reported that there is an increase in ovulation rate of 0.73 ova for every 10 kg increase in service weight. A similar relationship has also been reported by other workers. (Bowman et al., 1961; Omtvedt et al., 1965; O'Bannon et al., 1966).

Brooks and Cooper (1972) reviewed that when normal ovulation rate of gilt is in the range of 11-12 ova, further increase in ovulation rate are unlikely to have significant effect on litter size as maternal limitation rather than ovulation rate determines the size of litter produced. According to Anderson and Melampy (1972) neither age nor weight significantly influenced ovulation rate and lack of variation with either age or body weight may be due to the ad libitum feeding throughout growing period, especially during first oestrous cycle.

Doroshov (1975) stated age at first oestrous with high body weight produced significantly higher ovulation rate than that of lower body weight. While Schiemann et al. (1976) reported mean number of ova at first oestrous, was no significant different with age and body weight.

Paterson and Lindsay (1980), Knott et al. (1984) studied the first three oestrous cycles and observed that the number of corpusluteum averaged 9.5, 11.1 and 13.1 respectively. The difference were significant.

Wandursku (1982), Andersson and Einarsson (1985) found the number of corpusluteum during first, third and fifth oestrus periods averaged 9.5, 11.1 and 13.1 respectively.

Miskovic et al. (1982) reported gilts when inseminated at first, second and third oestrus, with average age as 224, 245 and 265 days, the number of corpusluteum were 10.6, 12.0 and 11.7 respectively.

Arthur (1989) reported number of ovulation in first oestrus were low but it increases thereafter.

Zhao et al. (1985) studied in chinese pig, ovulation rate 9.5, 12.2, 13.4, 14.3, 15.0 respectively correlated with first five oestrous cycles.

Archibong et al. (1987) reported ovulation rate in gilts bred at first and third oestrous was 12.2 and 14.5 respectively with no significant difference in fertilization in contrast.

Conor and Vanlunnen (1988) concluded that ovulation rate does not alter from the first to third oestrous and its not affected by age and body weight at which mating occurs.

Wang et al. (1988) reported ovulation rate at first oestrous, eight month age and older female averaged 9.5, 16.7 and 31 respectively and from first to fifth oestrous ovulation rate increased by an average of 0.9/cycle.

King (1989) stated ovulation rate at puberty was positively correlated with live weight at 170 days and Abaigar (1992) reported ovulation rate significantly increased with increasing body weight.

2.4 Conception rate

Pay and Davies (1975) reported conception rate (72.5%) among gilts bred at puberal oestrus was significantly lower than bred at following oestrous.

In contrary Hughes and Cole (1975) reported puberal gilts had the conception rate as 92.4 per cent.

Libal and Wahlstrom (1976); Macpherson et al. (1977) found the conception rate among gilts bred at first oestrous (64% to 69.6%) was lower than that of (86% to 83%) those mated on third oestrus.

Hughes and Varley (1980) stated age or weight change play a significant rate in determination of conception rate.

Young and King (1981) observed a higher conception rate, among gilt bred at third oestrous.

Knott et al. (1984) found there is significant difference among conception rate and in three weight groups of gilts from 70-80, 91-100 and 109-116 kg as 76, 79 and 79 per cent respectively.

O'dehnal (1984) reported highest conception rate as 91.6 Vs 69.3 per cent with gilt mated at 300 and 190 days of age respectively.

2.5 Gestation period

Pregnancy or gestation begins at fertilization, Generally the length of gestation period is non variable factor and is unaffected by any external stimulus or the size of the litter carried as it is in other species. It has a mean value for the British white breeds of about 114 days (Braude et al. 1954) although the range can be from 110 to 120

days. Vlcek (1942) Chiboka (1981) reported average gestation length in local pigs ranged between 114 and 116.3 days, there was little or no dependence of gestation length on age at first service.

Omtvedt et al. (1965) observed that age and weight of gilt at breeding did not influence the gestation length, and average pig weight at birth increased as gestation length increased. Busko (1974) stated that earlier age of conception will have shorter duration of gestation and small litter size and higher still births.

Preinbergs et al. (1979) stated pregnancy duration averaged 115.8 $\pm$ 0.7 days, and ranged between 100-129 days. This duration was significantly affected by age of dam and litter size.

Huhn (1989) reported in German Landrace gilts the gestation period averaged 114.9 days. The number of litter born/litter was highest (9.69-10.8) for gilts with gestation period 112-115 days and lowest (7.51) after a gestation of 119 days and litter weight was higher (13.25 kg) after gestation of 115 days and lower (11.68 kg) of the 112 days. Piglet birth weight was decreasing with increasing litter size.

Tsitsyunskil and Mikhno (1990) observed in Landrace x Russian and Large White Sows tht gestation period averaged

114.98 (104-127) and 114.7 (92-133) days respectively and gestation period tended to increase with age of sow but, was not affected by season of insemination.

2.6 Litter performance

2.7.1 Effect of age

Plocek (1967) found that age of gilt at mating had little or no effect on the number of first litter born dead and preweaning death.

Bhasan (1969), Skiba (1969) observed that litter size and litter weight at birth and at two months of age positively correlated with age of dam. Stolic (1972) found, litter size of 8.89 for 9-12 months and 9.66 for 21.24 months old of dam and he concluded average age at first farrowing was 388 days. Regression of litter size on age was 0.07.

Arganosa and Radillo (1972) observed litter size at birth positively correlated with age at farrowing and had no effect on average number of still births and preweaning mortality but it had significant effect on litter size at weaning. The percentage of still born piglet per litter decreased as the age advances (Vangelov and Co-workers, 1972).

Angelov (1973) and Kapko and Takoreva (1974) reported in Bulgarian fattened pigs, litter performances were positively correlated with age at first insemination.

Pavocov (1974); Stankovic et al. (1974) ; Beremski and Germanova (1974) reported age at first mating was not significantly correlated with litter traits.

Antie and Trbojevic (1975) found gilt mated at earlier life had smaller litters and larger service period than older one.

Hugh and Cole (1976); Libal and Whalstrom (1976) found that gilt bred at different ages (Oestrous periods) had no significant advantage in their litter performance. Chiboka (1981) stated only weaning weight tended to increase with delay in age at mating.

MacPherson et al. (1977) found considerable difference in first litter performance for gilts mated at different treat periods.

Brooks and Smith (1977) reported gilts mated at an average of 198 days produced smaller first litters than mated at 237 days but over five litters the number of piglets born differed by only 0.2 per cent.

Chapman et al. (1978) observed a relationship between age at first farrowing and litter size and stated that breeding at younger age was not detrimental.

Sukhdeo et al. (1979), Vidovic and Isokov (1979) stated age at conception was significantly correlated with number of live born and still born (0.10 and 0.08 respectively), litter size and weight at 28 days.

Young and King (1981) found there was tendency towards increased litter size at birth and weaning, when breeding was delayed to third oestrus. But the differences were not statistically significant, although delaying upto third oestrus required extra food and accommodation.

Oswagwuh and Akpokodje (1981) studied the prevalence of dystocia, losses at parturition and post partum following early mating in Nigerian pigs. Mating at eight months of age had smaller mean litter size than those which were delayed in age as (2.3 vs 3.6), lower piglet both weight (0.9 vs 1.0 kg), a higher incidence of dystocia (4 out of 6 vs. 1 out of 9) higher piglet mortality at birth (57 vs 9 per cent) and at days of age (79 vs 59 per cent).

Lecyk (1983) observed in Polish Large White (PLW) gilts mated first at 6-9 months of age, had litter size as

11.1 to 11.6 at birth and 10.5 to 10.9 at 21 days of age, and recommended six months as age at first mating for PLW breeds.

Zeman et al. (1984) reported that effect of age at first mating was significant only for first litter and have concluded the optimum age at first mating was 220 to 240 days.

Hovorka and Associates (1984) reported that gilts, mated at seven, eight, nine and 10, months of ages had no significant difference in their litter performance. In contrast Salehar and Popovic (1984) found gilts age at mating was significantly correlated with fertility traits. Kirkwood and Aherne (1985) concluded that neither age nor weight were reliable indices of reproductive development and a minimum adipose to lean tissue ratio also is a prerequisite for superior measure.

Ignjatovic and Dobrikovic (1986) reported in Swedish Landrale x Large White gilts aged 201-231, 232-262 and 263-293 days at first conception, had litter size average of 10.1, 10.2 and 10.4, litter weight at birth 13.2, 13.7 and 13.7 kg, litter size at weaning 8.8, 9.2 and 9.3, and litter weight at weaning 61.1, 65.4 and 66.1 kg respectively.

Mandic et al. (1988) reported mating at an average of 218 days age had no adverse effect on later reproductive performance similarly, Kozma (1988) and Dimov et al (1988)

stated age at first mating had number effect on litter performance service period.

Whittemore et al. (1988); Mercer and Francis (1988) showed a significant relationship between age at first service and total number of born in the litter and suggested the minimum age for breeding as 240 days.

Gregor and Staaks (1989) compared gilts, mating from 215 days of age resulted in a decrease of 0.45 live born piglets in litter size and mating from 235 days age leads to decrease of 0.29 piglets respectively. It is suggested that daily gain of 490 to 530 g.combined with body weight of 115 kg is necessary for the early mating gilt.

Chhabra et al. (1989) and Stefanek (1990) observed in large white gilts, the age at first mating had significant effect on their litter performance.

Glei and Schbegel (1990); Young et al. (1990) reported that the litter performance of gilts bred at earlier Vs later ages had no significant effect on age at first mating. There is little gained from delaying mating beyond 220 days of age and the recommend age at mating was 200 days (Paterson, 1990).

Kharouf et al. (1992) found litter size at first parity increased as age at first mating delayed, but this

difference was not effected in subsequent parities. Increasing an age at first mating had decreased length of reproductive life and concluded, for maximised productive efficiency age at first mating was about 270 days.

Wang and Sung (1992) reported that in Landrace, Yorkshire and Duroc gilts where mated at age of 13-14 month and 11 months, had litter size as 8.53, 8.3 and 7.8 Vs 8.2, 7.7 and 7.3, litter weight as 44.6, 37.2 and 34.3 kg Vs 42.1, 33.5, 33.0 kg at 21 days respectively.

Lal et al (1988); Rydhmer (1992) reported, only 20 per cent surviving piglets weighed less than one kg. in litters of more than 10, the lightest piglet had only 50 per cent chance for survival, while in litters of less than 10, had 80 per cent piglets survived. Its suggested that increasing litter size may increase piglet mortality.

2.6.2 Body weight

Since increase in age in usually associated with increase in body weight, it might be expected that litter performance would also be correlated with weight of the animal. There are much conflicting evidences concerning the influence of absolute weight on litter performance.

Omtvedt et al. (1965) and Skiba (1969) reported an increase in weight at breeding resulted significant increase in litter size and litter weight.

Pay and Davies (1973) reported mating at lower body weight had lower conception, and smaller litter size, but average birth weight did not vary significantly.

Vangelov and Coworkers (1972) found correlation between body weight at first conception and litter size, litter weight at birth and weaning were not significant but had highest correlation with number of live born piglets.

Kapko and Takareva (1974); Pavcov (1974) reported litter performance were positively correlated with dams breeding weight. Beremski and Germanova (1973 and 1974) recommended for better piglet production females with approx. 120 kg body weight ± breeding

Plamadeala and Damaschin (1976) found gilts mated at 115 and 95 kg, had number of live born per litter average of 8.6 Vs 7.9, number of still born as 0.3 Vs 0.6, piglet birth weight 990 Vs 910 g, litter size 7.9 Vs 6.8 and litter weight as 33.3 Vs 26.8 kg at 21 days respectively. Hovell et al. (1977) reported gilts mated at heavier (100 Vs 80 kg) had 1.5 more piglets but had no effect on the number piglet born.

Lopez et al. (1979) found weight at first mating had significant effect on litter performance and gilts mated at 80 to 90 kg body weight had poorer performance. It was concluded that gilts should not be mated at body weight of less than 90 kg.

Lopez et al. (1982) studied gilts mated at body weight of approximately 84.8, 96.4, 106.3, 116.4, 126.5, 135.2, 145.7 and 160.7 kg at ages of 210-480 days. Gilts mated at 84.8 kg had significantly smaller litters than other seven groups. Body weight at mating had no significant effect on piglet birth weight. Knott et al. (1984), Zeman and Associates (1984) reported none of reproductive traits were significantly associated with difference in mean age and body weight at mating.

Mandic et al. (1988), Kirwood and Thacker (1989) King (1989) reported neither the subsequent reproductive efficiency of gilt after parturition nor their litter performance were significantly affected by body weight at mating.

Chhabra et al. (1989) reported in large white gilts first conceived at body weight average of 121.76, 128.7, 139.75, 160.17 and 186.6 kg had litter size as 9.48, 10.32, 10.94, 11.17 and 10.40, litter weight as 11.48, 13.02, 13.30, 13.37 and 11.56 kg at birth respectively.

Paterson (1990) reviewed the body weight at first mating on reproductive performance of gilts and concluded. that little to be gained from delaying mating. As a management strategy mating of gilts at body weight of more than 100 kg was recommended.

Heinze et al. (1990), Heinze and Johne (1991), analysed gilts mated at weight <115, 116-125, 126-135, 136-145 and >145 kg at 278 days, had no significant effect on litter performance.

Newton and Mahan (1993) reported in gilts body weight at meeting had no significant effect on litter performance and piglet mortality increased with initial breeding weight.

2.7 Weight changes

2.7.1 During gestation period

Body condition and weight change are often quoted as being important determinants of ability to hold the service.

Greater weight gain during pregnancy resulted in greater number of litter born/litter (Stewart 1945; Robertson et al., 1951; Haines et al., 1959).

Lodge et al. (1961) reported that there was a consistent increase in rate of gain during fourth week,

followed by marked check in gain around sixth week of pregnancy. In general the higher gain in weight was during earlier part of pregnancy.

Omtvedt et al. (1965) found correlation between breeding weight of dam and weight gain during gestation. It was negatively (-0.14) correlated with litter size and positively correlated (0.16) with average pig weight at birth. Total weight gain during gestation was 43.6 kg for gilt.

Tomov and associates (1971) found that daily weight gain during pregnancy and weight loss during suckling period were correlated with breeding weight of dam.

Brooks and Smith (1980) found that early mated gilts caught up with initially heavier and by the middle of second pregnancy and had similar pattern of weight change thereafter. Heavier mated gilts lost more fat during first lactation.

2.7.2 During lactation

Majerciak (1972) reported Czechoslovaiken improved white pigs the body weight at mating 132.8 kg for gilt and 177.7 kg for sow during pregnancy period gained the body weight of 172.44 and 224.8 kg and during lactation there was a loss of body weight as 27 and 30.2 kg respectively. This loss was greatest in first 15-18 days and least 46-56 days.

Baker et al. (1969) reported a linear decrease in weight gain during lactation and increase in feed consumption during gestation.

Plamadela and Damashin (1976) reported body weight of gilts at mating and weight at remating was significantly correlated. Bogos and Cojochoru (1988) found in Landrace gilts the body weight averaged 121.1 and 178.8 kg at mating and remating and 161.6 and 227.8 kg at beginning and end of pregnancy respectively.

Young et al. (1990) reported the linear increase in age increased body weight and back fat at first mating. These trends continued throughout gestation and at farrowing as well as 21 days post farrow. However, during lactation there tended to be decrease in weight and backfat loss.

Newton and Mahan (1993) reported gilts with average body weight of 260, 295 kg were mated at eight months of age. Among two groups second one had a higher food consumption and lower body weight loss during lactation, although there was no difference in litter size among that groups.

2.8 Food consumption during gestation and suckling period

Dean and Tribble (1961); Baker et al. (1969); Legault and Dagorn (1973) demonstrated that increased food intake

during pregnancy leads to reduced voluntary feed intake during lactation.

Macpherson et al. (1977) found when gilts were mated at different ages, their performance over three parities were almost identical but did increase food consumption in delayed mating, which resulted in poorer food utilization.

Brooks and Smith (1980) reported delaying age at mating to second oestrous will consume more food. Gilts mated at younger age consumed 6.2 per cent less food/unit of weaner live weight over other. These difference were disappeared in later pregnancies.

Zeman et al. (1984) found age and body weight at first mating of gilt had no significant effect on food consumption per piglet produced.

Young et al. (1990) reported voluntary feed intake during lactation increased during each successive week. There was linear or linear plus quadratic ($P<0.05$) decrease in lactation feed intake as the gestation level of feeding increased.

Newton and Mahan (1993) reported heavier gilts at mating had higher food consumption although no difference in litter size.

2.9 Post weaning oestrus interval

The interval from weaning to oestrus is influenced by a number of variable factors.

Legault and Dagorn (1973) reported weaning to conception interval being consistently longer for later mated gilts and had a slight increase in the farrowing interval as mating age increased.

Lengele and co-workers (1976) studied correlation between weight of sow at weaning and post partum oestrus interval were -0.260 ($P<0.05$). Sow weighing 84-111, 112-125 and 120-148 kg at weaning, the interval between weaning and conception 22.27, 18.88 and 7 days respectively. This variation in weaning weight of dam was accounted by litter size, and piglet weight during lactation.

Young and king (1981) reported weaning to oestrus interval was not influenced by initial breeding on first or third oestrus cycle of gilt.

Heyde et al. (1982) found highly significant correlation (0.30) between the interval from weaning to oestrus and weight of sow at end of first lactation.

Canope and Raynaud (1982) studied reproductive performance of large white and creale breeds and reported age

at first fertile mating as 212.9, 283.0 days and body weight of 53.8, 110 kg, had interval from weaning to oestrus as 22.96 and 23.6 days respectively.

King et al. (1982) concluded interval from weaning to mating was significantly correlated (0.23) with losses of weight and fat during lactation, but not related to age.

Paterson and Lindsay (1983) reported weaning to estrus interval declined by 5.8 days for each 10 day increases in initial age and by four days for each 10 kg increase in initial weight.

Garcia et al. (1989) studied in Piau pigs, that age and body weight at first mating and reported an average of 308.35 $\pm$ 66.53 days and 77.42 $\pm$ 17 kg respectively and the interval from weaning to oestrus was <10 days in 67.08 per cent and >22 days in 18.22 per cent of pigs.

Materials and Methods

MATERIALS AND METHODS

Forty eight (48) eight weeks old weaned female piglings of Large White Yorkshire (LWY) breed belonging to University Pig Breeding Farm, Kerala Agricultural University, Mannuthy having an average body weight of 8 kg were utilized for the study. The piglings were maintained on rations which contained the following ingredients.

Ingredients, parts/1000	Grade of ration	
	Cp.18%	Cp.14%
Yellow maize	400	300
Groundnut cake	150	80
Rice polish	170	280
Wheat bran	170	280
Dried unsalted fish	100	50
Common salts	5	5
Mineral mixture	5	5
Vitamin AB_2D_3 (Rovimix)*, g	100	100

* Rovimix -a product of Roche products Ltd., Bombay.

Design

Piglings were randomly assigned to eight groups A, B, C, D and E, F, G, H each consisting of six pigs. They were

housed in identical styes with cemented floor and each having a covered area of 6.15 m^2. All of the styes had access to concrete floor open exercise yards with wallowing tanks.

Pigs were fed with a standard concentrate having 18 per cent crude protein (CP) for a period of four months from weaning and thereafter rations having 14 per cent CP till advanced gestation. The rations during suckling period contained 18 per cent CP.

The rations contained a calculated level of 74 per cent total digestible nutrients (TDN) or Digestible Energy 3256 Kcal.

During the experimental period feed was provided to pigs twice daily and allowed to consume as much as they could in an hour. Clean drinking water was made available to the animals at all times. All groups of pigs were reared under the managemental conditions prevailed at the University pig breeding farm. Pigs in each of the groups A, B, C and D were bred to designated boars on attaining seven, eight, nine and ten months of age respectively. Similarly pigs in groups E, F, G and H were bred to designated boars on attaining body weight of 70, 80, 90 and 100 kg respectively irrespective of their ages. Two pigs from each of the groups were slaughtered within a week after mating and the genital organs were

dissected out properly removing all extraneous tissues. The gross weight of genitalia were recorded. The organs were spread on a table and biometric measurements were recorded using a cotton thread, plastic graduated tape and vernier calipers.

Ovulation rate was recorded by counting the number of corpusluteum present on the ovaries as the procedure adopted by Nair (1970). Remaining four pigs in each of the groups were allowed to farrow and litters were weaned at 56 days after farrowing. Body weights were recorded wherever required during the mornings before feeding using a platform balance with built-in cage.

Management

All pregnant gilts, two weeks prior to expected date of farrowing were transferred to farrowing pens. Prior to admittance, they were dewormed, washed scrubed and sprayed against ectoparasites using a solution of Butox[#] (0.02%). All the pigs and their respective litters were housed separately till weaning. The piglets were administered parentarally Imferon[$] at rate of 1 ml/head intramuscularly on third day.

Imferon - A product of Rallis India Ltd.

$ Butox - A product of Hoechest India Ltd.

The follwing parameters were recorded

1. Growth pattern
    a. Fortnightly body weight
    b. Average daily gain in weight, it was calculated by the formula,

$$R_1 = \frac{W_2 - W_1}{t_2 - t_1}$$

where,

R_1 = average daily gain

W_2-W_1 = gain during period

t_2-t_1 = period of gain in days

2. Biometry of genitalia
    a. Length and weight of uterus and horns
    b. Weight of horns
    c. Ovulation rate

3. Conception rate
4. Length of gestation
5. Litter performance
    a. At birth
        (i) Litter size
        (ii) Litter weight
    b. At weaning
        (i) Litter size
        (ii) Litter weight

6. Weight gain/loss during gestation and suckling period
    a. Fortnightly weight during gestation
    b. Post weaning weight of dam

7. Feed consumption
    a. during gestation
    b. during suckling

8. Days required for onset of postweaning heat

Economics of breeding

The cost of production of weaned piglet and of per kg body weight were calculated in all groups assuming that feed represented 80 per cent of the total cost of production and the cost of maintenance of boar was identical to all the piglets.

The data collected during the course of study were statistically analysed as per the method described by Snedecor and Cochran (1967) and results interpreted.

Results

RESULTS

The results obtained during the course of the experiment on; age and body weight of gilt, litter size and litter weight at birth and weaning and feed intake during gestation and suckling period are summarised in Tables 4.1 to 4.14 and graphically depicted in Fig. 4.1 to 4.8.

4.1 Growth pattern

The fortnightly body weight of gilts from weaning to upto mating and their rate of gain, feed efficiency were presented in Table 4.1.

4.2 Conception rate and length of gestation period

The conception rate among diferent age group and body weight group is prescribed in table 4.3. Group A had lowest conception rate (72%) among all other groups. The length of gestation period is shown in Tables 4.2 and 4.3. There was no significant ($P>0.05$) difference between groups in both age and weight groups.

4.3 Genitalia development

The measurements of genital organs such as length, weight of uterus and horns, ovarian weight and ovulation rate are presented in Tables 4.4 and 4.5.

4.4 Litter performance

The litter performance at birth and weaning such as litter size, litter weight, number of still born and pre-weaning mortality are depicted in Tables 4.6 and 4.7.

4.5 Weight changes during gestation and suckling period

The prepartum and post weaning weight of dam are presented in Tables 4.8 and 4.9

4.6 Feed consumption during gestation and suckling period

The total and daily feed consumed during gestation and suckling period are shown in Tables 4.10 and 4.11.

4.7 Post weaning oestrus interval

The number of days required for the onset of post weaning heat are presented in Tables 4.12 and 4.13.

4.8 Economics of breeding

The cost of production per piglet and per kg body weight at weaning are presented in Table 4.14.

Table 4.1 Mean and standard error of fortnightly, daily gain in weight and feed conversion effeciency of pigs from weaning to 32 weeks

Age in fortnights	Body weight (kg)	Average daily gain (g)	Feed conversion efficiency	Percentage increase conversion in body weight
0	9.64 ± 0.82			
1	11.62 ± 0.81	137.84 ± 23.7	6.92 ± 0.92	20.8
2	14.33 ± 0.92	165.20 ± 16.63	6.03 ± 0.71	23.3
3	19.18 ± 1.03	226.74 ± 23.92	4.89 ± 0.43	34.3
4	24.24 ± 1.24	259.34 ± 22.7	4.43 ± 0.32	26.4
5	30.89 ± 1.12	317.96 ± 18.23	4.09 ± 0.21	27.4
6	37.97 ± 1.73	348.97 ± 14.61	3.97 ± 0.15	22.9
7	46.18 ± 1.43	381.80 ± 10.44	3.62 ± 0.14	21.6
8	54.37 ± 2.17	404.75 ± 9.48	3.63 ± 0.11	17.7
9	62.49 ± 2.91	420.43 ± 9.94	3.74 ± 0.14	14.9
10	69.96 ± 2.63	429.62 ± 8.83	3.98 ± 0.12	12.3
11	76.74 ± 3.07	433.73 ± 9.87	4.10 ± 0.19	10.2
12	83.48 ± 2.70	439.28 ± 10.05	4.19 ± 0.13	9.6
13	88.50 ± 3.29	431.00 ± 11.68	4.64 ± 0.16	7.8
14	95.62 ± 2.83	434.16 ± 10.72	4.72 ± 0.12	8.0
15	101.13 ± 3.29	434.42 ± 10.96	5.18 ± 0.16	6.7
16	107.64 ± 3.68	437.40 ± 12.31	5.19 ± 0.09	6.5

Fig.4.1 FORTNIGHTLY BODY WEIGHT OF PIGS FROM WEANING TO 16th FORTNIGHT

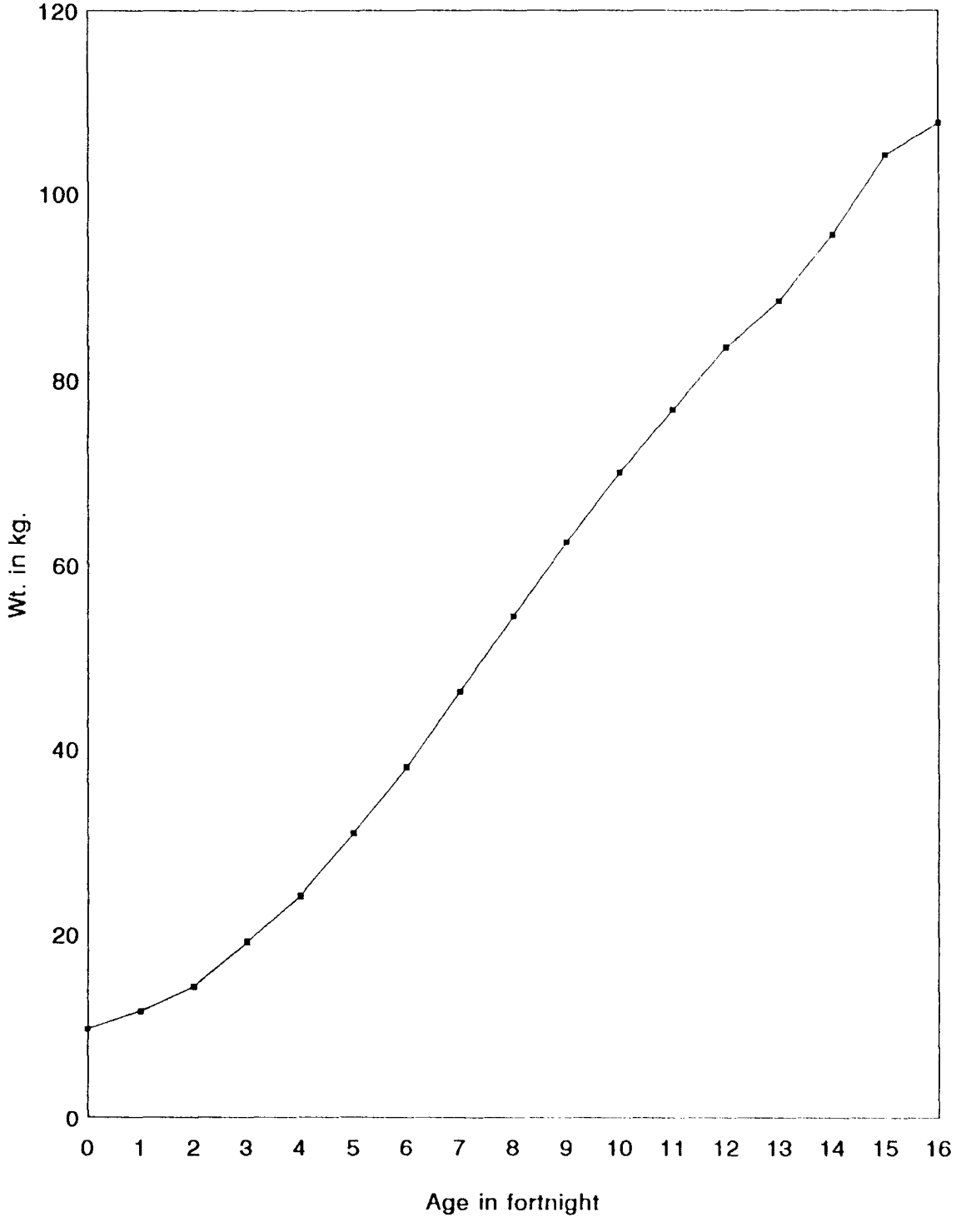


Fig.4.2 DAILY GAIN IN WEIGHT OF PIGS AT FORTNIGHTLY INTERVALS

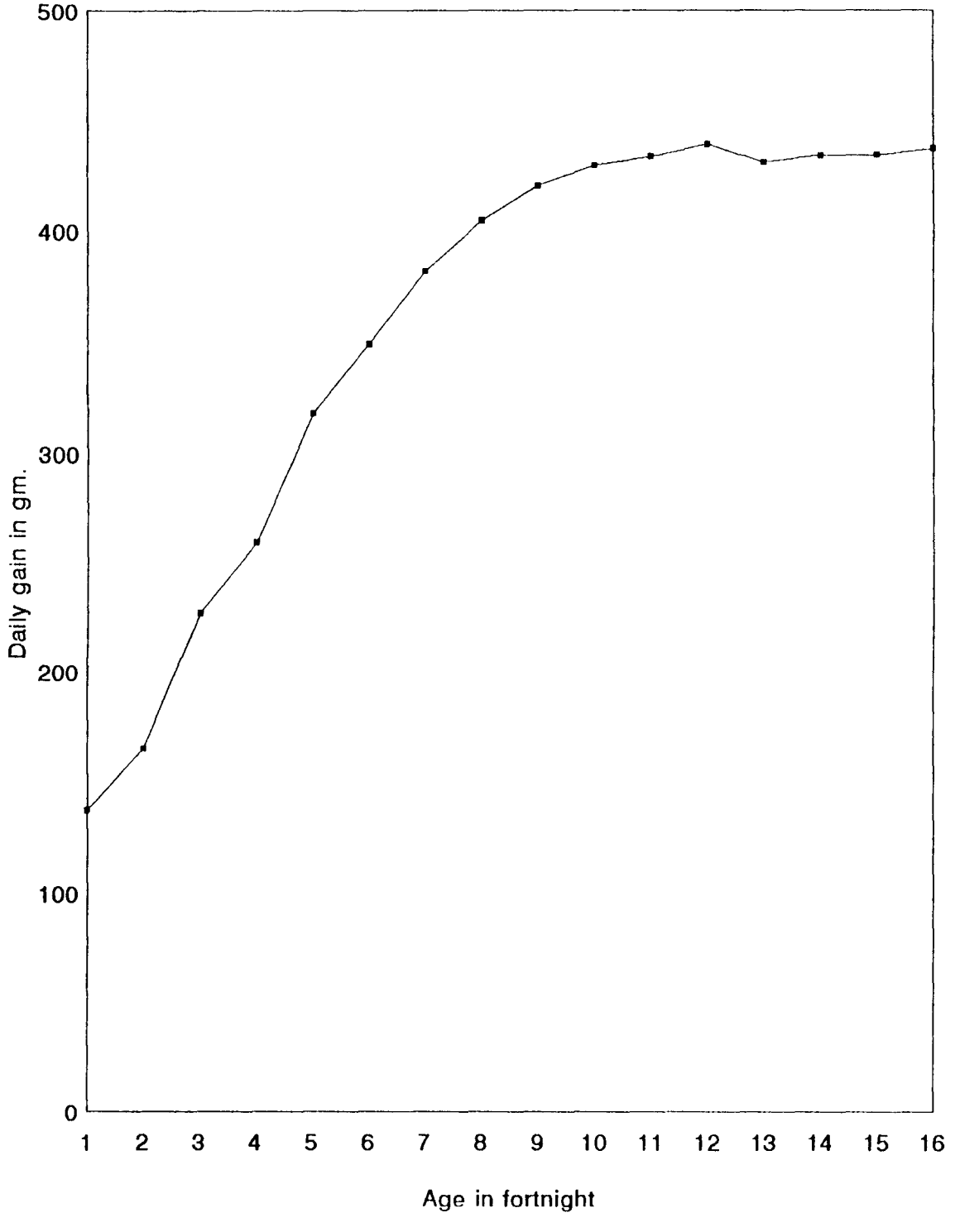


Fig.4.3 FEED CONVERSION EFFICIENCY OF PIGS FROM WEANING TO 16th FORTNIGHT

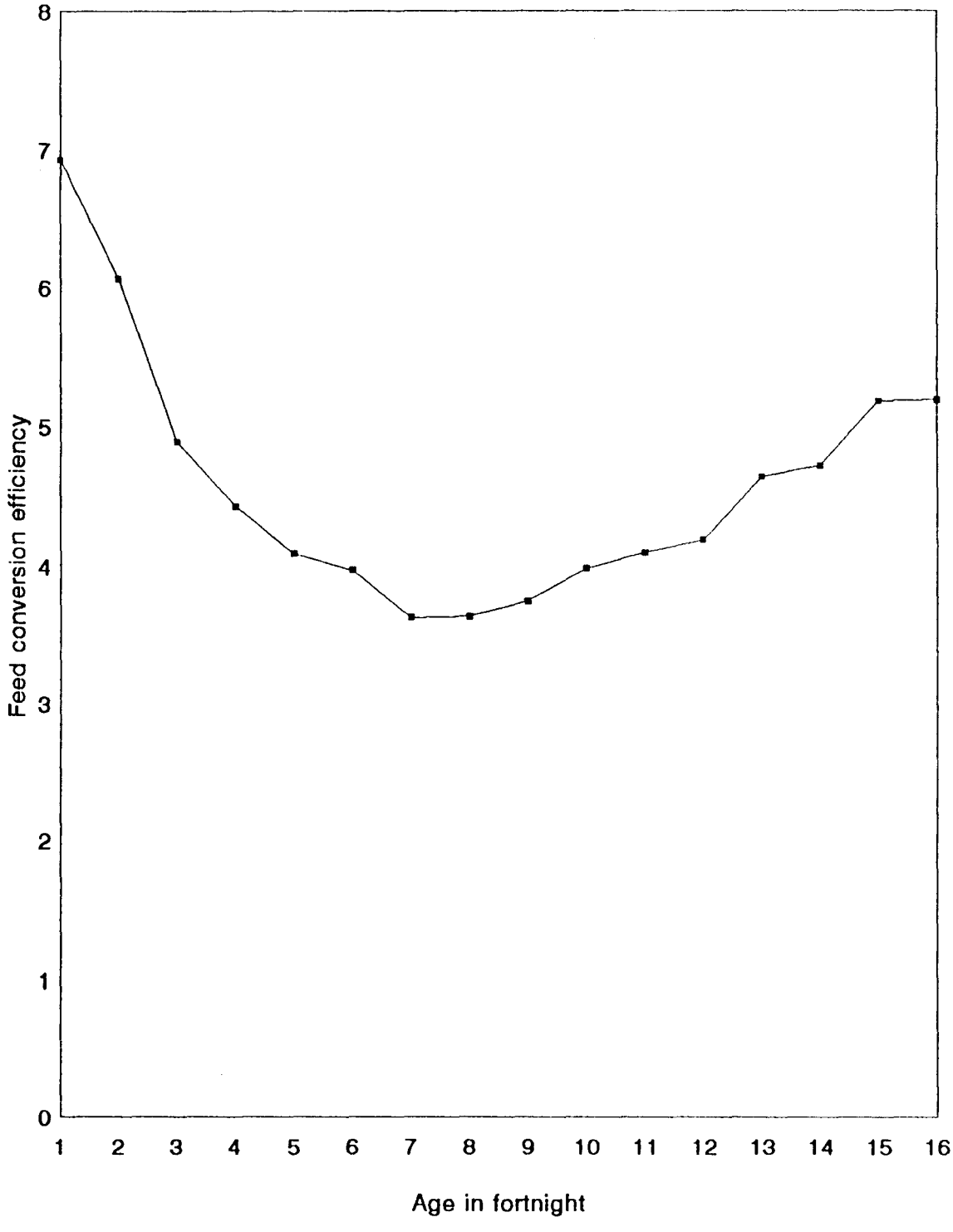


Table 4.2 Mean and SE of conception rate and length of gestation of pigs at varying ages

Traits	Agewise			
	A	B	C	D
Conception rate (%) NS	72.00	80.00	81.80	88.00
Gestation period (days), NS	113.00 ± 0.33	113.75 ± 0.34	113.75 ± 0.34	113.75 ± 0.35

NS - Non significant at (P>0.05)

Table 4.3 Mean and SE of conception rate and length of geststion of pigs at varying body weight

Traits	Body weightwise			
	E	F	G	H
Conception rate (%) NS	80.00	80.00	90.00	90.00
Gestation period (days), NS	113.00± 0.41	113.75± 0.44	113.75± 0.46	113.75± 0.47

NS - Non significant at (P>0.05)

Table 4.4 Mean and SE of length and weight of uterine horns, weight and number of corpusluteum in pigs of varying age groups

Groups	Uterus				Ovary				
	Length (cm)		Weight (gm)		Weight (gm)		Presence of CL, Nos.		
	Left	Right	Left	Right	Left	Right	Left	Right	Total
A	62.05± 2.14	61.75± 1.89	110.75± 0.54	110.25± 0.53	3.45± 0.30	3.35± 0.41	4.00± 0.10	3.00± 0.70	7.00± 0.71
B	71.32± 0.54	71.25± 0.89	127.50± 0.36	126.89± 0.86	3.95± 0.11	3.93± 0.52	6.00± 0.71	5.50± 0.43	11.50± 0.36
C	92.00± 2.14	92.30± 1.71	149.20± 1.57	148.00± 1.42	4.81± 0.78	4.77± 0.13	8.00± 0.00	6.50± 0.36	14.50± 0.36
D	102.00± 0.36	101.57± 0.71	163.75± 0.54	163.20± 0.71	5.47± 0.05	5.31± 0.10	8.00± 0.20	7.50± 0.36	15.50± 0.38

Table 4.5 Mean and SE of length and weight of uterine horns, weight and number of corpusluteum in pigs of varying body weight groups

Groups	Uterus				Ovary				
	Length (cm)		Weight (gm)		Weight (gm)		Presence of CL, Nos.		
	Left	Right	Left	Right	Left	Right	Left	Right	Total
E	76.00± 0.35	75.50± 0.67	134.75± 0.33	135.20± 0.35	3.94± 0.14	3.71± 0.11	6.00± 0.70	3.50± 0.42	9.50± 0.41
F	91.35± 0.82	91.05± 1.04	156.00± 0.1	155.60± 1.29	4.71± 0.09	4.50± 0.71	4.00± 0.71	5.50± 0.60	12.50± 1.02
G	107.05± 1.11	106.54± 1.07	169.20± 1.57	169.40± 0.64	5.51± 0.19	5.45± 1.10	7.50± 0.36	6.50± 0.36	14.00± 0.71
H	114.40± 1.14	113.70± 1.21	178.30± 1.93	177.60± 2.14	5.90± 0.17	5.83± 0.1	7.00± 0.71	8.00± 0.71	15.00± 0.71

Table 4.6 Mean and SE of litter Performance at varying ages

Traits	Agewise			
	A	B	C	D
Litter size at birth (Nos.)	c 5.75± 0.61	b 8.00± 0.59	a 9.75± 0.63	a 10.50± 0.61
Alive	c 4.25± 0.46	b 7.25± 0.44	a 9.00± 0.46	a 10.00± 0.44
Not alive	1.50± 0.34	0.75± 0.36	0.75± 0.34	0.50± 0.36
Still birth (%)	35.29	10.34	8.30	5.00
Litter weight at birth (kg)	d 5.33± 0.61	c 8.56± 0.73	b 10.80± 0.68	a 13.05± 0.3
Live litter weight at birth (kg)	d 4.40± 0.52	c 8.00± 0.62	b 10.43± 0.58	a 12.08± 0.57
Average piglet weight (kg)	1.03	1.10	1.15	1.21
Litter size at weaning (Nos.)	d 4.25± 0.34	c 6.75± 0.42	b 8.00± 0.38	a 9.00± 0.36
Litter weight at weaning (kg)	d 37.80± 2.95	c 60.15± 3.12	b 89.15± 2.96	a 106.99± 3.08
Average piglet weight (kg)	8.89	8.90	11.30	11.80
Pre weaning mortality (%)	0.00	7.00	12.00	10.00

Figures having different superscription in a row differ significantly ($P<0.01$)

Fig.4.4 LITTER SIZE AND LITTER WEIGHT AT BIRTH AT DIFFERENT AGE AND WEIGHT OF PIGS

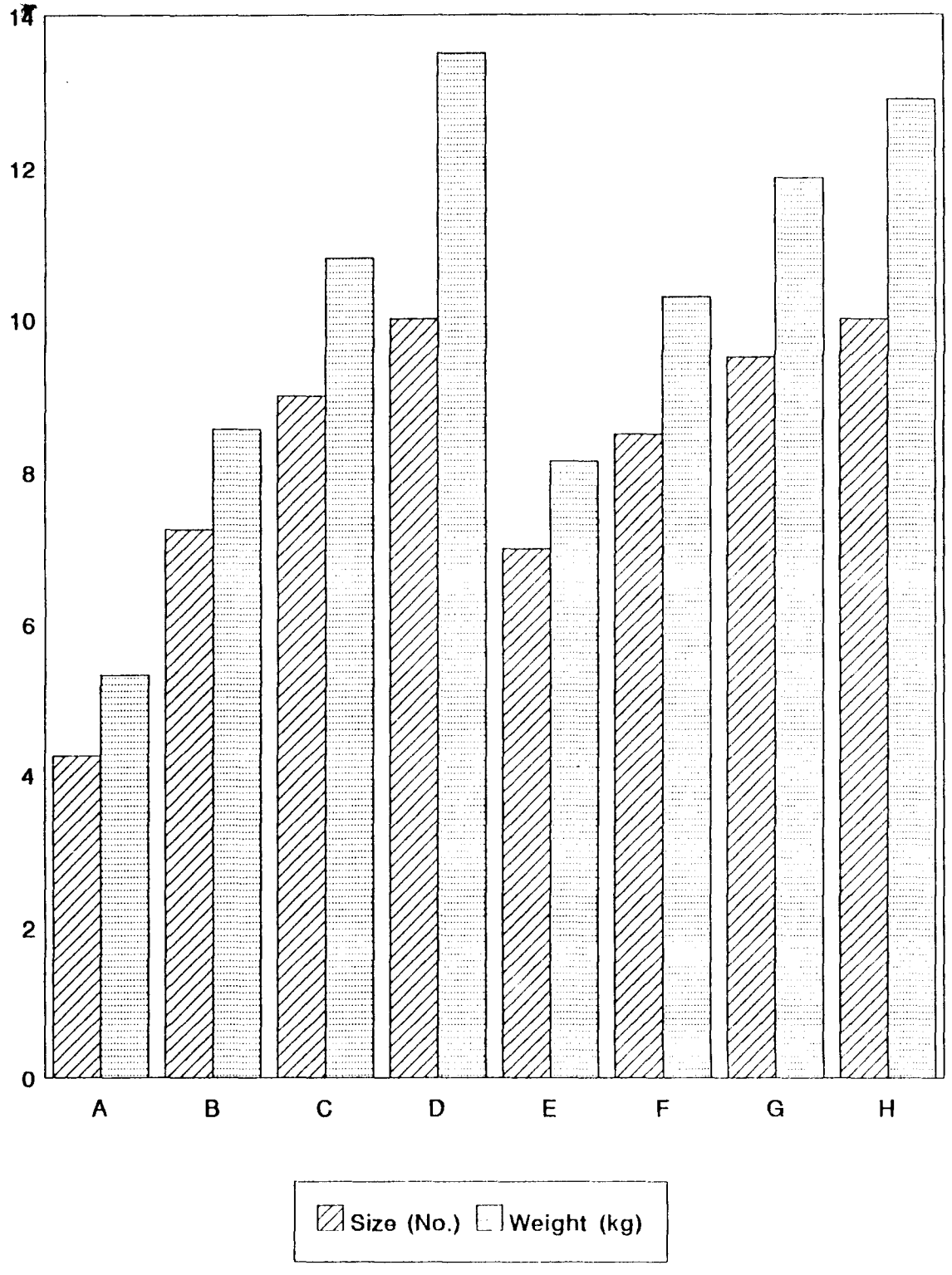


Table 4.7 Mean and SE of litter Performance at varying body weight

Traits	Body weightwise			
	E	F	G	H
Litter size at birth (Nos.)	c 7.75±0.52	b 9.50±0.53	a 10.30±0.61	a 10.50±0.52
Alive	c 7.00±0.35	b 8.50±0.41	a 9.50±0.37	a 10.00±0.38
Not alive	0.75±0.38	1.00±0.38	0.50±0.36	0.50±0.38
Still birth (%)	10.70	11.76	5.26	5.00
Litter weight at birth (kg)	d 8.13±0.48	c 10.29±0.53	b 11.86±0.49	a 12.90±0.51
Live litter weight at birth (kg)	d 7.63±0.44	c 9.43±0.41	b 11.43±0.52	a 12.42±0.51
Average piglet weight at birth (kg)	1.08	1.11	1.20	1.23
Litter size at weaning (Nos.)	c 6.00±0.38	b 7.75±0.44	a 9.00±0.42	a 9.00±0.38
Litter weight at weaning (kg)	d 58.99±3.14	c 79.40±3.20	b 103.10±3.18	a 110.35±3.41
Average piglet weight (kg)	9.73	10.20	11.40	12.20
Pre weaning mortality (%)	14.00	9.00	6.00	10.00

Figures having different superscription in a row differ significantly ($P < 0.01$)

Fig.4.5 LITTER SIZE AT WEANING OF PIGS IN DIFFERENT AGE AND WEIGHT

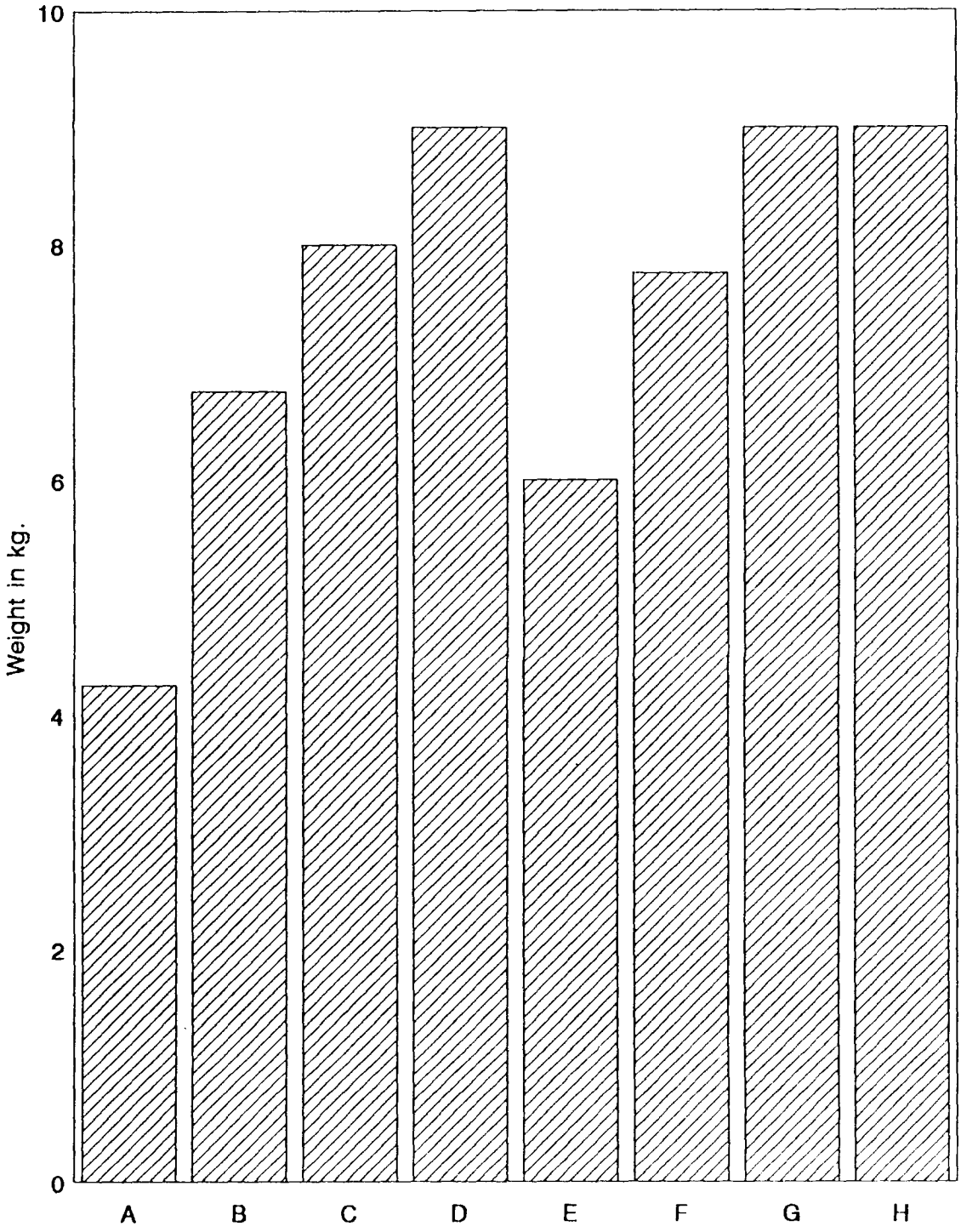


Fig.4.6 LITTER WEIGHT AT WEANING OF PIGS IN DIFFERENT AGE AND WEIGHT GROUPS

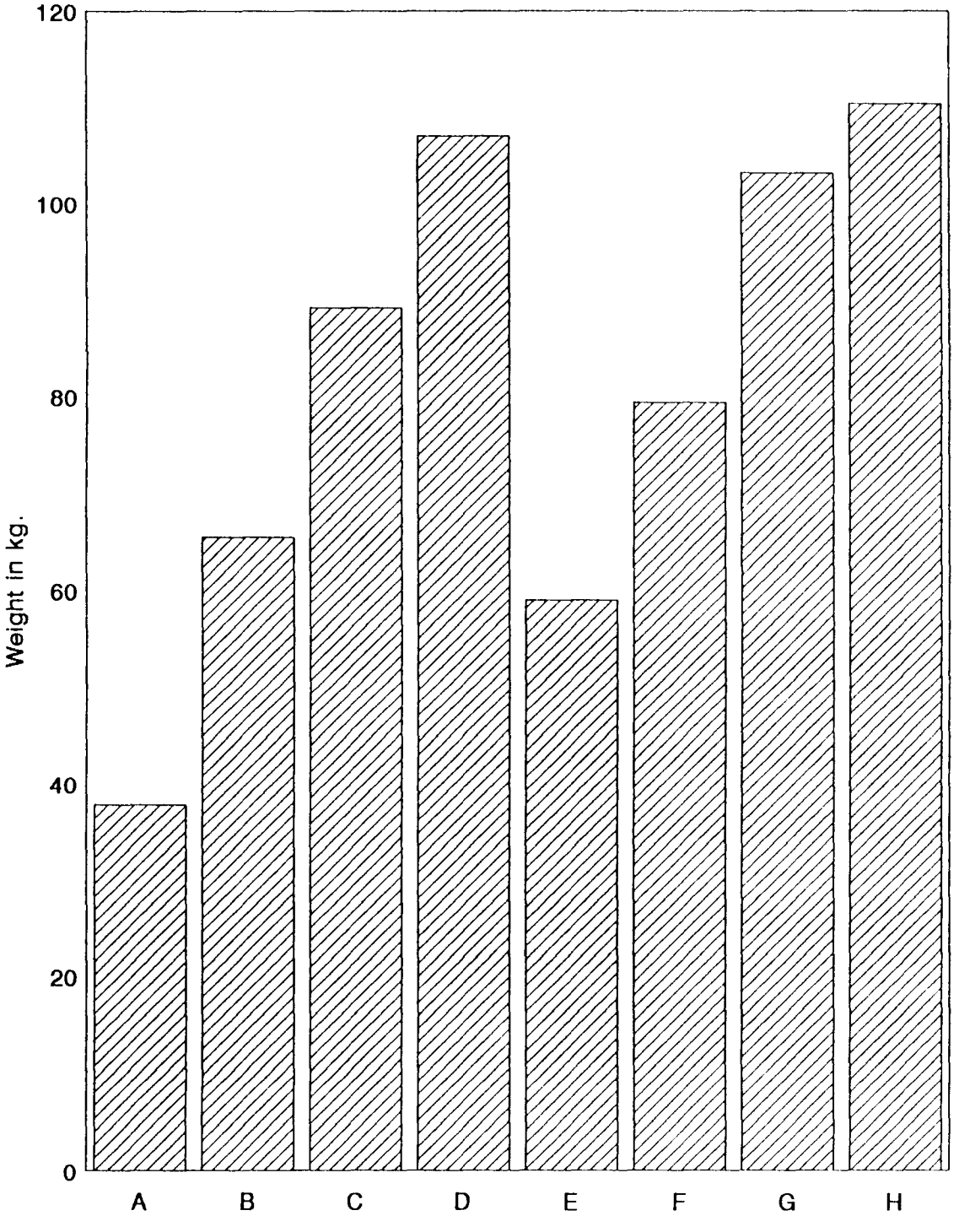


Table 4.8 Mean and SE of weight changes of sows during gestation and suckling period in varying ages

Traits	Agewise			
	A	B	C	D
Initial weight	66.7± 3.2	75.4± 2.8	84.23± 3.1	93.16± 2.3
Weight gain during gestation (kg)	39.40± 0.77	38.40± 1.26	39.20± 1.18	40.12± 0.34
Average daily gain (g)	358	352	356	365
	d	c	b	a
Weight of dam at weaning (kg)	51.23± 2.11	63.82± 2.34	73.00± 2.27	85.00± 1.98

Figures having different superscription differ significantly ($P < 0.01$)

Table 4.9 Mean and SE of weight changes of sows during gestation and suckling period in varying body weight

Traits	Body weight wise			
	E	F	G	H
Initial weight (kg)	73.6± 2.6	86.00± 3.2	94.00± 3.34	103.00± 2.3
Weight gain during gestation (kg)	39.67± 0.73	40.05± 1.28	39.68± 1.18	39.80± 0.66
Average daily gain (g)	360	364	361	362
Weight of the dam at weaning (kg)	d 59.25± 2.41	c 74.33± 2.32	b 82.75± 3.09	a 88.13± 2.28

Figures having different superscription differ significantly (P <0.01)

Table 4.10 Mean and SE of feed consumption during gestation and lactation period of pigs of varying ages

Traits	Agewise			
	A	B	C	D
Gestation period (kg)	330.1± 2.09	336.3± 2.40	354.6± 1.60	363.9± 1.55
Average daily consumption	2.88	2.95	3.10	3.18
During lactation	d 170.80± 1.69	c 178.97± 1.66	b 189.53± 1.72	a 189.18± 1.84
Averge daily consumption	3.04	3.19	3.38	3.37

Figures having different superscription in a row differ significantly ($P < 0.01$)

Fig.4.7 WEIGHT CHANGES DURING GESTATION AND SUCKLING PERIOD

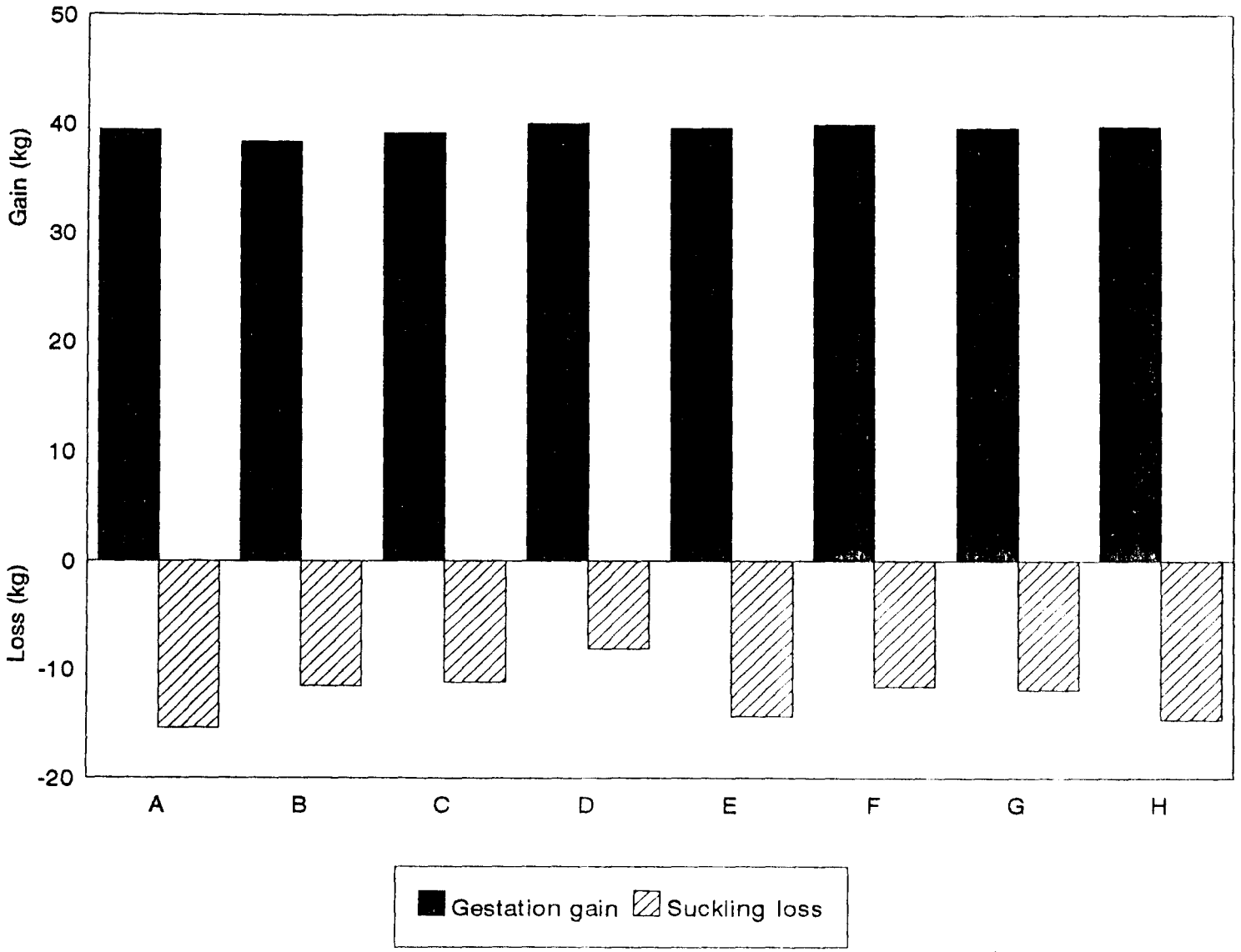


Table 4.11 Mean and SE of food consumption during gestation and lactation period of pigs in varying body weight

Traits	Body weight			
	E	F	G	H
Gestation period (kg)	336.71± 1.23	362.83± 1.64	369.25± 1.79	368.71± 1.38
Average daily consumption	2.94	3.17	3.24	3.22
During lactation	d 11.20± 1.21	c 189.95± 1.34	b 190.98± 1.19	a 191.63± 1.88
Averge daily consumption	3.06	3.39	3.41	3.42

Figures having different superscription in a row differ significantly ($P < 0.01$)

Table 4.12 Mean and SE of onset of post weaning oestrous in sows bred at varying ages

Traits	Agewise			
	A	B	C	D
Onset of post weaning oestrous interval (days)	7.75± 1.91	6.50± 1.93	4.00± 2.11	3.50± 1.91

Table 4.13 Mean and SE of onset of post weaning oestrous interval of sows bred at varying body weight

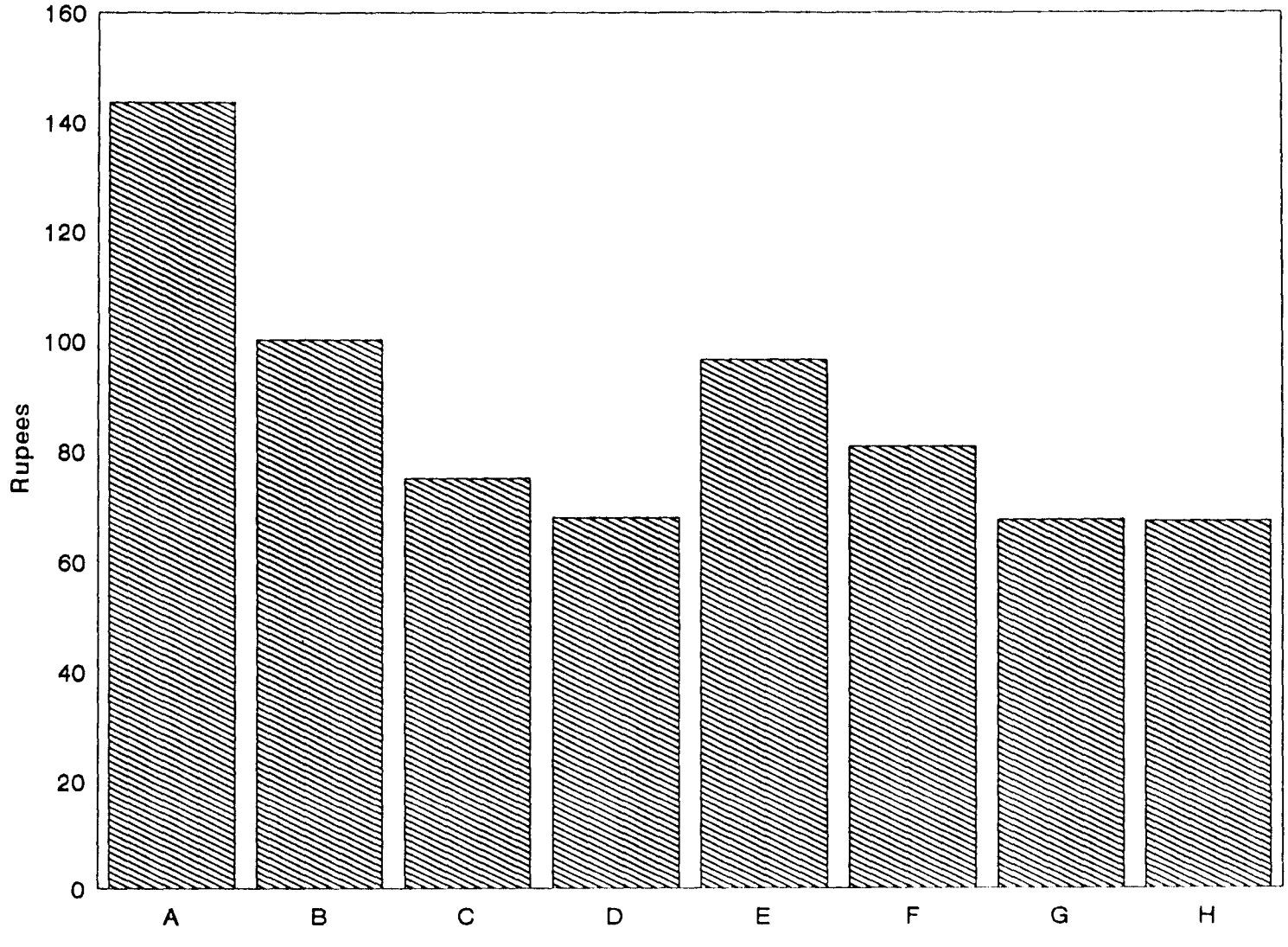
Traits	Body weightwise			
	E	F	G	H
Onset of post weaning oestrous interval (days)	6.75± 2.10	5.50± 1.91	5.50± 1.91	3.50± 2.01

Table 4.14 Cost of weaned piglets and per kg body weight in different groups

Traits	Agewise				Body weightwise			
	A	B	C	D	E	F	G	H
Cost of feed (Rs.)	17368.82	19278.96	21369.75	23130.60	18237.58	20517.10	22250.88	23684.57
Cost of production (Rs.)	21711.02	24098.70	26712.16	28913.25	22796.97	25646.38	27813.60	29605.71
Litter size at weaning	4.25	6.75	8.00	9.00	6.00	7.75	9.00	9.00
Average weight at weaning (kg)	8.89	8.90	11.30	11.80	9.73	10.20	11.40	12.20
Cost per kg piglet (Rs.) at weaning	143.59	100.16	74.97	67.82	96.61	80.75	67.42	67.19

Assumed that cost of feed represented 80% of cost production and cost of maintanance boar was the same for all treatment groups

Fig.4.8 COST OF PRODUCTION PER kg. BODY WEIGHT OF WEANED PIGLET



Discussion

DISCUSSION

The results of the experiment are discussed hereunder.

5.1 Growth pattern

5.1.1 Fortnightly body weights

The body weight of pigs in all the groups have increased progressively from weaning to 16th fortnight (Table 4.1) indicating that as age advanced the body weight also increased. However, the increase in body weight was non-significant.

According to Brody (1945) the body weights of animals increase from birth in a way characteristic to the species. Abarca and Tapia (1963) reported growth between 53 and 346 days as linear Ittner and Hughes (1938) on plotting live weight against age, obtained a smooth curve between 70 and 168 days of age and a diminishing increment after 168 days. A similar pattern of growth was obtained in the present study for pigs in all the groups.

5.1.2 Daily gain

pigs in all the groups showed progressive increase in the average daily gain in weight from 137.84 $\pm$ 23.7 g at first fortnight to 461.7 g. at 16th fortnight.

The observations in the present study is in agreement with that of Brody (1945), Kanis and Koops (1990).

5.1.3 Percentage rate of gain in weight

The percentage of growth rate based on the previous months weight, for all the pigs increased from weaning (Table 4.1). It was maximum at younger ages and steadily declined as the age of the animals advanced. A similar pattern in the percentage of gain in body weight was observed by Bhagwat and Shahastrabuddhe (1971) and Sassendran (1979).

The initial decrease in the percentage gain was probably due to the weaning stress.

5.1.4 Feed conversion efficiency

It can be seen from Table 4.1, that pigs in all groups the feed conversion efficiency was 6.03 at second fortnight and the efficiency was improved thereafter till 12th fortnight. However, the conversion efficiency was found to be reduced from 13th to 16th fortnight (4.64 ± 0.16 to 5.19 ± 0.09).

Rate of growth has been reported to be highly correlated with feed efficiency (Robison, 1970). The correlation of feed conversion ratio with average daily gain

as -0.79 in Large White pigs finished from 30 to 90 kg body weight.

A decrease in feed efficiency with increasing age and body weight has been observed Brooks et al. (1964) Koinarski (1983) reported that the feed efficiency decreased in the successive age periods of 10-12 weeks, 22-34 weeks and 34-42 weeks. Kumar and Barsaul (1987) observed a higher daily consumption and feed conversion ratio for the period from 126 to 159 days than for period from one to 126 days of age.

A poor feed conversion efficiency from weaning to second fortnight, as observed in the present study, may be due to the stress at weaning of piglets.

5.2 Conception rate

It can be seen from Table 4.2 and 4.3 the rate of conception increased from 72 percentage in pigs having 7 months of age to 88 percentage at 10 months of age (Pay and Davies (1975), Libal and Wahlstorm (1976), Macpherson et al. (1977), Hughes and Varely (1980), Young and King (1981), Knott et al. (1984) and O'denral (1984). The conception was 80 percentage in pigs having 70 Kg. and increased to 90 percentage when the body weight was 100 Kg. Hughes and Cole (1975).

5.3 Length of gestation

It can be seen from Table 4.2 and 4.3 that the length of gestation was not influnced either by age or bodyweight. In all pigs the gestation length was 113 or 113.75 (corrected to 114) days. This observation is in confirmity with studies of Vlcek (1942), Omtvedt et al. (1965), Chiboka (1981) and Huhn (1989).

5.4 Genitalia development

From Table 4.4 and 4.5 it can be seen that the length and weight of uterus and ovary were increasing commensurate with age and body weight of animal. These findings indicated that the organ weights in mature animals increased with a fractional power of body weight. The ratio of organ weight to body weight declined with increasing body weight. The left and right side of uterus and ovaries did not vary significantly in their biometrical measurement. The observation in the present study were fallen within range of values reported by Nair (1970) Chertkov (1976), Wu et al. (1987 and 1988), Christenson et al (1987), Das et al. (1988).

5.5 Ovulation rate

It can be seen from Table 4.4 and 4.5 that the number of corpusluteum in the ovaries were increasing with the age.

The number of corpus lutuem in ovaries at seven months of age was seven, it increased by 64.3 percentage at eight months, 107 percentage at nine months and 114.3 percentage at ten months of age. However, the increase was only 7.3 percentage in pigs at ten months of age when compared to nine months. The maximum number of ova are shed at nine and ten months of age. This observation lends support to studies of Knott et al. (1984), Andersson and Enarsson (1982, 1985), Arthur (1989) and Abaiger (1992). While the number of ova shed at 70 Kg body weight was 9.5, it increased by 31.6 percentage at 80 Kg., 47.4 percentage at 90 Kg. and 57.9 percentage at 100 Kg. The increase in the ovulation at 100 Kg. over 90 kg body weight was only 10.5 percentage, whil there was an increase 15.8 percentage from 80 to 90 Kg body weight.

The ovulation rate was found maximum at nine and 10 months of age or 90 and 100 Kg. bodyweight. The increase in ovulation rates in pigs often over nine months and 100 over 90 kg bodyweights have not been appreciably higher. Brooks et al (1970), Miskovic et al (1982).

These findings are at variance with the studies of Andersson and Melampy (1972), Schiemann et al. (1976), Archibong et al. (1987),Conor and Vanlunnen (1988) who have reported that neither age nor body weight significantly influenced ovulation rate.

5.6 Litter performance

5.6.1 Litter size at birth

It can be seen from Table 4.6 that the litter size at birth was significantly higher ($P<0.01$) at eight, nine ane ten months than at seven months. However, the difference in litter size at nine and ten months was not significant. This observation is in agreement with that of Stolic (1972), Brooks and Cole (1973), Pay and Davies (1973), Macpherson et al. (1977), Sukhdeo et al. (1979), Young and King (1981), Oswagwah and Akopokodje (1981) and Chobra et al. (1989). The same trend was observed in regard to the number of piglets born alive. The percentage of stillbirth was maximum at pigs bred at seven months of age and least when pigs bred at ten months. A similar observation has been reported by Sukhodeo et al. (1979) and Oswagwah and Akopokadje (1981).

When the pigs were bred at 90 or 100 kg body weight the litter size was significantly ($p<0.01$) higher than 70 or 80 Kg. although the pigs bred at 80 Kg. produced significantly ($p<0.01$) higher litter size than at 70 kg (Table 4.7). This observation lends to the support to Macperson et al. (1977), Young and King (1981) and Chhabra et al. (1989).

5.6.2 Litter weight at birth

It can be seen from Table 4.6 that the litter weight at birth has significantly increased with advancing age. It was higher in pigs bred at ten months of age than seven, eight and nine months. Similar trend was observed in regard to the live litter weight at birth by Kapko and Takorova (1973), Pavcov (1974), Hovell et al. (1977) Lopez et al. (1979), Chhabra et al. (1989) Peterson (1990).

The average piglet weight was significantly ($P<0.01$) higher in older pigs as reported by Lopez (1982) Knott et al. (1984), and Mandic et al. (1988).

The litter weight at bitrth was higher in pigs bred at 100 Kg. body weight than at 70 Kg. This observation is in accordance with that of Brooks and cole (1973), Sukhdeo et al. (1979) and Oswagwah and Akopokodje (1981). It indicates body weight at breeding had an effect on litter weight at birth (Table 4.7). The average piglet weight at birth was higher in pigs bred at 90 and 100 Kg body weight, which ranged from 1.08 tol.23 kg.

5.6.3 Litter size and litter weight at weaning

It can be seen from Table 4.6 that the litter size at weaning was significantly ($P<0.01$) higher in pigs bred at ten

months of age when compare to pigs of seven and eight months and the same trend was observed in litter weight at weaning. The observation in the present study is in support of the reports of Chiboka (1981), Sukhdeo et al. (1979), Young and King (1981), Igjatovic and Dabrikovic (1986) and Wang and Sung (1992).

The average piglet weight was at weaning higher (9 Kg.) in pigs bred at nine and ten months of age than at seven and eight months, and this observation is at variance with that of Strankovic et al. (1974), Hugh and Cole (1976), Brooks and Smith (1977) and Young et al. (1990). The percentage of preweaning mortality was found to be maximum in pigs bred at nine and ten months of age than at seven or eight as reported by Lal et al. (1988) and Rydhmer (1992).

The pigs bred at 90 or 100 kg body weight had significantly ($p<0.01$) higher litter size at weaning than pigs bred at seven and eight months of age, and increase in littersize noticed in pigs bred at 90 and 100 kg body weight was not significant (Table 4.7). The same trend was observed in litter weight at weaning. Pigs bred at 100 kg body weight had higher litter weight when compare to 70 Kg. body weight. This observation is in support of Young and King (1981).

The percentage of preweaning mortality was observed higher in pigs bred at 70 and 100 Kg.body weight when compare to 80 and 90 Kg. This observation is in agreement with that of Lal et al. (1988).

5.7 Weight changes during gestation and suckling period

From Table 4.8 it can be seen that the weight gain during gestation did not differ when pigs bred at varying ages. The weight gain during gestation ranged from 38.4 to 40.1 kg. The average daily gain during gestation period ranged from 352 to 365 g.

The same trend was observed when the pigs bred at varying body weight. Table 4.9 indicating that neither age nor body weight have any influence on the weight gain during gestation period.

Lodge et al. (1961) and Babu and Deo (1992) have reported that pre partum body weight gain was linearly related with advancing gestation period.

However, this finding is at variance with the studies of Robertson et al. (1951), Haines et al. (1959) and Brooks and Smith (1980)

The weight of the dam at weaning significantly ($P<0.01$) differed when the pigs bred at varying ages. It was higher as

the age of pig advanced. Baker et al. (1969), and Young et al. (1990) have reported a similar observation.

The pigs bred at seven and eight months of age had greater loss when compared to the older pigs of nine and ten months of age. Similar trend was obseved when the pigs bred at different body weights. The weight loss during suckling period was higher in pigs bred at 70 kg and 100 kg body weight and loss ranged from 8 to 14.5 kg (Newton and Mahan (1993).

The loss in weight during suckling period according to Macpherson et al. (1977) is due to the lactational stress

5.8 Feed consumption

5.8.1 During gestation and Suckling period.

From Table 4.10 it can be seen that the feed consumed during gestation did not differ in pigs bred at varying ages. The average daily consumption with ranged from 2.9 to 3.2 kg. The same trend was observed in pigs bred at varying body weight. A similar observation have been reported by Dean and Tribble (1961), and Baker et al. (1969) Colin (1980), Brooks and smith (1980)

The feed consumption during suckling period was significantly ($P<0.01$) higher in older pigs. The pigs bred at 7 and 8 months of age had an average daily consumption of

3.1 kg when compared to the 3.4 kg in pigs bred at 9 and 10 months of age. The same trend was observed when pigs bred at varying body weight (Table 4.11). The pigs bred at 70 kg body weight had lower feed consumption than 80, 90 and 100 kg body weight. This observation in accordance with Macpherson et al. (1977) and Newton and Mahan (1993).

5.9 Post weaning estrus

It can be seen from Table 4.12 and 4.13 that onset of post weaning estrus has not varied significantly in pigs of varying age and body weight. It indicates that neither age nor body weight is a criterion for onset of past weaning heat. The pigs in all groups manifested the onset of post-weaning oestrus within a week. This observation is accordance with Young and King (1981), King et al. (1982) but in contrast with studies of Legault and Dagorn (1973), Lengele et al. (1976), Heyde et al. (1982), Paterson and Lindsay (1983) and Garcia et al. (1989). They reported interval from weaning to oestrus was <10 days in 67.08 per cent and >22 days in 18.22 per cent of pigs.

5.10 Economics of breeding

It can be seen that from Table 4.14 that the feed cost at the cost of production were lowest when pigs bred at seven months of age and maximum at 10 months. However, the average

cost per kg piglet weaned was higher at young ages. The cost per kg piglet weaned was seen progressively reduced from Rs.143.59/kg in group A to Rs.67.82/kg in group D. Older pigs especially pigs of 10 months of age weaned more number of heavier piglets and hence the cost per kg was lowest. However, when pigs were bred at 10months of age, instead of 9 months, it costed an additional amount of Rs.1760.9 towards feed alone and produced only an extra piglet.

The scenario was more clear when pigs were bred at different body weights. The feedcost and total cost of production have progressively increased when pigs were bred at 70 kg, 80 kg, 90 kg and 100 kg respectively. However, pigs bred at 90 and 100 kg weaned equal number of piglets although the latter weaned slightly heavier piglets. When pigs were bred at 100 kg instead of at 90 kg, it costed an additional amount of Rs.1433.7 towards feed alone without any added advantage.

It may be concluded based on economic point of view that gilts may be bred at nine months of age and or 90 kg body weight for optimum yield.

Summary

SUMMARY

An experiment was conducted to determine the influence of age and body weight of gilt on the breeding performance and feed intake during gestation and suckling period, and to recommend an optimum age and body weight for breeding.

Forty eight weaned female piglings were randomly assigned to eight groups as A, B, C, D, E, F, G and H, each containing six. All the groups were maintained under prevailing condition at University Pig Breeding Farm, Kerala Agricultural University, Mannuthy. Pigs in group A, B, C and D were bred to designated boars on attaining seven, eight, nine and ten month of age respectively. Similarly pigs in group E, F, G and H were bred to designated boars on attaining body weight of 70, 80, 90 and 100 kg respectively irrespective of their ages. Fortnightly body weight was recorded. Two pigs from each of the groups were slaughtered within a week after mating and the genital organs studied for their physical development such as length and weight of uterus and ovarian weight, number of corpusluteum on the ovary.

The remaining four pigs in each of the groups were allowed to farrow to study the performance of litter, feed consumed during gestation and suckling period and onset of post weaning estrus. The data were statistically analysed.

The fortnightly body weight was seen linearly increased as age advanced. The average gain in body weight for pigs in all groups increased progressively with age, from weaning and reached a peak at 12th fortnight and thereafter declined gradually.

The conception rate did not vary significantly with the age and body weight of pigs. Gilts mated at seven month of age had lowest percentage of conception when compared to other groups. The length of gestation did not vary significantly between the groups.

The length and weight of uterus and ovarian weight increased with increasing order of age and body weight. The ovulation rate increased with age and body weight groups.

Pigs bred at seven month of age (Group E) had poor litter size at birth and larger number of still borns but breeding at nine month (Group C) and 10 month of age (Group D) had no significant difference in their size. Similarly gilts bred at 80 (Group F) and 90 kg body weight (Group G) had no significant difference in their litter size.

The litter size and weight at weaning were found to be increasing progressively with age. Gilt bred at 90 kg and 100 kg body weight did not vary significantly ($P>0.05$) in their litter size.

The prepartum body weight gain was increased as gestation advanced. The weight of dam at weaning varied with age and body weight at breeding.

The onset of post weaning estrus did not vary significantly between groups.

The food consumption of dam increased during gestation and suckling periods in all groups.

The cost of production per litter and piglet at weaning varied with the age and body weight of pigs. Breeding at seven months was found to be costliest per litter production While breeding at nine months and 10 months of age and 90 and 100 kg body weight produced litters at lowest cost. The total cost of production per litter at weaning was higher in pigs bred at 10 months of age and 100 kg weight than at 9 months and 90 kg.

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INFLUENCE OF AGE AND WEIGHT OF GILT ON BREEDING PERFORMANCE AND FEED INTAKE DURING GESTATION AND SUCKLING PERIOD

By

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ABSTRACT OF A THESIS

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ABSTRACT

An experiment was conducted to determine the influence of age and body weight of gilt on the breeding performance and feed intake during gestation and suckling period and to recommend an optimum age and body weight for breeding. Forty eight weaned female piglings were randomly assigned into eight (A, B, C, D, E, F, G and H) groups each consisting of six. Pigs in group A, B, C and D were bred to designated boars on attaining seven, eight, nine and ten month of age. Similarly pigs in group E, F, G and H were bred to designated boars on attaining body weight of 70, 80, 90 and 100 kg respectively, irrespective their ages. Two pigs from each group were slaughtered within a week after mating and the genitalia were studied. The length, weight of uterus, ovarian weight and ovulation rate were increasing with increasing order of age and body weight of the animal. Remaining four pig in each of group were allowed to farrow and their litter performance was studied. The litter size, weight at birth and weaning were significantly ($P<0.01$) different between the groups. The prepartum weight gain did not vary significantly in pigs of different age and weight. The weight at weaning significantly ($P<0.01$) varied in pigs of different age and body weight at breeding. The food consumed during gestation

period was not significantly different between groups while during suckling period it significantly ($P<0.01$) varied with age and body weight at breeding. The onset of post weaning estrus did not vary significantly between groups.

Overall results suggested that economic and optimum age and weight at breeding was nine months and 90 kg.